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HEAD START EVALUATION AND RESEARCH CENTER, UNIVERSITY OF KANSAS. REPORT NO. VIIB. ESTABLISHMENT OF NONVERBAL COLOR DISCRIMINATION RESPONSES TO AUDITORY COLOR-LABELING STIMULI AND SUBSEQUENT EFFECTS ON COLOR-LABELING RESPONSES.

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Seventeen preschool children were administered two color-discrimination pretests, verbal and nonverbal. The five children who scored lowest were chosen to recieve the color program. Four scored elow 85 percent on the nonverbal pretest, whereas the other 12 children scored above 85 percent. On the verbal pretest, all five experimental subjects scored below 80 percent, while the 12 remaining children scored above 80 percent. The color program administered to the five children was designed to teach eight colors. Three teaching procedures using color-stimulus cards were used. Each was nonverbal in character, requiring the child to point to the correct stimulus. The experimenter did present the verbal stimulus incidentally, however, when asking that the subject point to the particular color. Response reinforcement was given throughout the program. Except for one child on the verbal test, all subjects scored 90 percent or more on the nonverbal and verbal posttests. It was concluded that the color program not only taught the children the intended visual-stimulus discriminations, but also nonprogramed verbal-stimulus information. (WD)

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The University of Kansas Head Start Research and Evaluation Center

VII. b.

"Establishment of Nonverbal Color Discrimination Responses to Auditory Color-Labeling Stimuli and Subsequent Effects on Color-Labeling Responses"

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ESTABLISHMENT OF NONVERBAL COLOR DISCRIMINATION RESPONSES TO AUDITORY COLOR-LABELING STIMULI AND SUBSEQUENT EFFECTS ON COLOR-LABELING RESPONSES[1]

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Running head: Programming Color Discriminations

A color program was designed to establish a nonverbal (pointing) response to visual and auditory stimuli associated with eight colors. Nonverbal pre- and posttests were administered to preschool children to select Ss who demonstrated few or none of the skills the program was designed to teach. These tests also provided information regarding the efficacy of the program for teaching these skills. A verbal color-naming pre- and posttest was also administered to determine if, through pairing auditory color-labeling stimuli with the visual stimuli during discrimination training, there was any effect on the Ss' verbal color-labeling responses even though these responses were neither required nor reinforced during the program sessions.

Submitted: November, 1967

ESTABLISHMENT OF NONVERBAL COLOR DISCRIMINATION RESPONSES TO AUDITORY COLOR-LABELING STIMULI AND SUBSEQUENT EFFECTS ON COLOR-LABELING RESPONSES[1]

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It is apparent that many discriminations of preschool children are often initially made on the basis of color. Most children attending preschool acquire color discriminations and color-naming responses, probably through the manipulation of materials and through peer and teacher verbal color-naming interactions. However, it is not uncommon to find several children from any preschool group who lack some color discriminations and/or color-labeling behavior. Our experience has been that traditional methods, even though concentrated and presented in a one-to-one situation, result in even greater confusion of colors (more errors) for these children. The adults often resort to attributing this to a suspected color-blindness problem.

The color program reported in this study was designed for those children who have not acquired color discriminations through the "usual" (but not clearly understood) procedures. It required nonverbal pointing responses by the S subsequent to the presentation of an auditory stimulus simultaneous with a visual stimulus complex. Following acquisition of the color discrimination, as evidenced by the correct pointing response, a test of the S's performance on verbal color-naming was made. These responses were neither required nor reinforced if emitted during the program sessions. Therefore, also investigated were the effects of the presentation of auditory color-naming stimuli by E simultaneous with the visual stimuli upon the subsequent color-naming behavior of S when only a pointing response was required during the program. Within the technology of programming it is often stressed that only one response should be modified at a time. To be consistent with this suggestion when teaching color discrimination and naming, one would first reinforce a simple (already acquired) pointing response to a specific color and then separately program color-naming responses. It is apparent, however, that the color name (as an auditory stimulus presented vocally by E during color discrimination training) in addition to the visual color stimulus becomes a discriminative stimulus signalling the occurrence of reinforcement if responded to correctly. Because few, if any, error responses occur in a well designed program, reinforcement occurs on practically every trial. In the present study, one response results in reinforcement, but two discriminative stimuli are being presented--one visual, one auditory. The fact that a color name is a discriminative stimulus for a child does not guarantee that it will become a part of that child's vocal response repertoire. However, it would be consistent, within the framework of reinforcement to guess that a child who has had a past history of reinforcement for verbal imitative behavior would have a high probability of imitating others' vocal utterances which have in the past taken on discriminative properties. This would not necessarily be predicted for those children with speech defects or who lack such a history of reinforcement such as children belonging to a low-economic level.

METHOD

Subjects

From a group of 17 children attending the University of Kansas Preschool Laboratory, five were selected for study. These five had demonstrated low correct response percentages when the pretests were administered. The ages of the Ss ranged from 3½ to 5.

Experimental Setting

The experimental setting was the same for administering the pre- and posttests as well as for the program sessions. Each S was brought to a research room located on the second floor of the preschool laboratory. They were seated at a table across from E. Distracting stimuli were kept to a minimum.

Reinforcement Procedures

During the initial program sessions, each S was instructed by E that correct responses on all phases of the program would result in the receipt of green "tokens"[3] (small plastic chips) which were redeemable following each session for small edibles or red tokens (the medium of exchange used in the nursery school to purchase special activities). Usually a child received three or four paper cups of green tokens per program session. Reinforcement was not presented during the pre- and posttests.

Pretest Procedures

Two pretests (verbal and nonverbal) were administered to the total group of 17 children. The nonverbal test was designed to measure nonverbal (pointing) responses to color patches, subsequent to E's presentations of the corresponding auditory stimuli. The verbal pretest measured color-naming responses emitted by S subsequent to E asking "What color is this?" while presenting a pretest color stimulus card.

The testing stimuli were eight 2½ X 5 inch white cards, each of which had a 1 X 1½ inch colored, plastic-paper patch[4] attached to the center. Each card had a different color. For every trial of the nonverbal pretest, three pretest stimulus cards were placed on the table in front of S. One of the cards was predetermined as the correct choice (S+) and the remaining two were distractors (S-). After placing the cards of a pretest trial in front of S, E presented the auditory stimulus, "Point to _____.", to which S was to respond by pointing to the correct (S+) card, i.e., the card corresponding to the auditory stimulus presented by E. Each of the eight color cards was presented three times during the 24 pretest trials. The eight colors appeared in random order with no color preceding itself.

For each trial of the verbal pretest, only one pretest color stimulus card (the same cards as used in the nonverbal pretest) was placed before the child and E asked, "What color is this?" Each color was presented three times according to the same criterion as prescribed for the nonverbal pretest.

Four of the 17 children made less than 85% correct responses on the nonverbal pretest and less than 80% on the verbal pretest and were thus included as subjects for the color program. One additional child was included because

one pretest score fell below 85% (i.e., 56% correct verbal naming response) even though correct responses on the nonverbal prestest were 100%. The other 12 children in the preschool group scored above 85% correct responses on the nonverbal and above 80% on the verbal pretests and were thus excluded from the study.

The Color Program

The program was designed to teach eight colors, the four primary colors red, blue, green and yellow in addition to orange, purple, brown and black. Each S proceeded through the entire program of all colors regardless of pretest correct responses on individual colors. This was done because each color was presented with every other color at some time during the program.

The program stimuli were 5" X 8" index cards on which three different colored stimuli, 1" X 1½", of the colored-plastic paper appeared. The program consisted of seven basic sets, each of which was designed to teach one color (with the exception of the first set which taught two colors) while reviewing all colors presented in previous sets.[5] If an S had difficulty in discriminating between two specific colors, e.g., red and blue, additional sets were designed to teach this specific discrimination. These sets were numbered 9 through 14. All sets were modified for each S's specific problems, i.e., the cards from one set were placed within another set when specific color confusions occurred.

Each of the basic sets of color program cards consisted of three subsets: (1) a review set; (2) introduction of a new color; and (3) presentation of new and review colors under terminal stages of fading.[6] The term, fading, in this study refers to the manipulation of the saturation level (i.e., from a light shade of blue to dark blue) of the colors during their presentation in the program.

The following is a detailed description of the above three subset procedures used within a session that taught one of the eight color discriminations.

1. The first subset of program stimulus cards was presented first in each experimental session. This subset consisted of presentations of all review colors (i.e., colors for which S had previously reached a criterion pointing response) as both S+ (correct stimulus) and S- (a distractor or incorrect stimulus). The new color for each basic set appeared from the beginning in this subset but only as S- in various positions and at initially low saturation levels which were gradually increased until the saturation level of the new color stimuli approximately matched those of the review colors. E placed the first program stimulus card in front of S and said, "Point to _____." These instructions were gradually diminished to E vocalizing only the color name corresponding to the correct stimulus. The same instructions were presented on all trials unless incorrect responses were emitted, i.e., if S pointed to an S- for a particular trial then E provided a remedial demonstration procedure. For this E pointed to the correct stimulus color patch and said, "This is _____. Point to _____." After each correct response, E placed a green token in the cup (placed on the table before S) and said,"Very good" or some similar social praise.

2. The second subset of the basic set was presented immediately following the first subset but during the same session as that

subset. At the end of the first subset the new color had not been presented as S+, but had increased in saturation in the S- positions until it approximately matched that of the review colors being presented as S+. The initial cards of the second subset had only the new color at full intensity. No review colors, as S-'s, were present. Only the position of the new color changed from trial to trial in these initial cards of this subset. On subsequent cards, the review colors were introduced as S-'s at very low saturation levels. The shades were gradually increased across trials of this subset until the S-'s were approximately equal in saturation level to the S+. The only S+ appearing throughout this subset was the new color and it was constantly at full saturation level across trials. The instructions for the initial cards of this second subset were "This is _____. (E points to the new color, the only color appearing on the card) Point to_____." These instructions were gradually diminished to "Point to _____." and to E vocalizing only the new color name for that set. Remedial and reinforcement procedures, identical to those in the first subset, were used.

3. The third subset of the basic program stimulus set was presented immediately following the second. Initially, in this subset, only the review colors were presented as S+. Both the new and review colors (when not presented as the S+) appeared as S-. The new color, once again, initially appeared only as a S- on each card. The saturation was increased across trials (more quickly this time) to approximate the satuaration levels of the review colors. When the saturation level of the new color was comparable to the review colors, the new color was presented in random order across trials with the review colors as both S+ and S- (depending on whether it was the color to be chosen or the distractor). Therefore, on the final trials of this subset, all colors were at full saturation level and thus the response requirements of these trials matched that of the required terminal performance. Remedial and reinforcement procedures were identical to those in the previous subsets.

Posttest Procedure

Both verbal and nonverbal posttests were administered to the five Ss upon their completion of the program. The verbal posttest differed slightly from the verbal pretest in that cards similar to the color-program stimulus cards were used for the posttest rather than the single color cards. Consequently, in both the verbal and nonverbal posttests each color was presented as S+ in the presence of two distractors for three trials. Thus, as in the nonverbal pretest, each color was presented once in the presence of each of the seven other colors for three trials within the total of 24 trials.

RESULTS

Pretest

Figure 1 compares the pretest scores of the five programmed Ss with those of the other 12 children attending the nursery school. The left graph represents scores on the nonverbal (pointing response) pretest; the right, the verbal-color-naming pretest results.

Insert Figure 1 about here

Each of the Ss' percent correct responses for the total of eight colors are plotted on the ordinate. Subject numbers representing the non-programmed Ss and subject letters representing the programmed Ss are plotted on the abscissa. The "cutoff" point, dividing the percentages of the programmed Ss from those of the non-programmed Ss, is represented by a straight line at the 85% point on the nonverbal pretest graph and 80% on the verbal pretest graph. There is no overlap in scores between the two groups with the exception of grogrammed Subject E who emitted 100% correct responses on the nonverbal pretest, but only 56% correct verbal color-naming responses. Even though Subject E was above the "cutoff" line on the nonverbal pretest, it was decided to administer the program to determine its effects on verbal color-naming behavior.

The mean percent correct nonverbal pretest scores for Ss not in the program was 98%. Ss in the program obtained an average of 70% correct nonverbal color responses. For non-programmed Ss the pretest mean correct verbal color-naming response was 88% and for programmed subjects it was 56%. These results indicate two quite different groups of Ss with respect to both their nonverbal (pointing) color responses and their verbal color-naming behavior.

Figure 2 compares the verbal and nonverbal, pre- and posttest percentages for the programmed Ss.

Insert Figure 2 about here

The left graph of Figure 2 indicates a significant increase in correct responses between the nonverbal pre- and posttests for four of the programmed Ss. The fifth S, Subject E, maintained the previously obtained pretest score of 100%. All the posttest percentages of the programmed Ss are well above the "cutoff" line and appear quite comparable to the pretest percentages of the 12 non-programmed subjects.

The graph on the right side of Figure 2 gives the total percent correct verbal color-naming responses for the programmed Ss on both pre- and posttests. Even though verbal color labels were not directly programmed or required as a response from the Ss the percentages of correct responses for four of the five programmed Ss increased from very low on the pretest to above the "cutoff" line, 90% or better, in correct color labeling on the posttest. Subject B did not show as large an increase from the verbal pretest to the posttest as he did between the nonverbal tests. Further, his verbal posttest percentage of correct responses still remained well below the "cutoff" line, indicating that little "bonus" was realized in the verbal labeling responses of this S through completing the nonverbal color program. Subject E who demonstrated nonverbal color discrimination prior to taking the color program improved her color-labeling behavior even though that behavior was not directly reinforced on the nonverbal program.

DISCUSSION

Our interest in preacademic programming led to the development of the described color program. Further, interest in the technology of programming *per se* also resulted in testing the acquisition of behavior not directly programmed.

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The color program appeared to be adequate for training color discrimination for the five Ss who tested below the "cutoff" point on the nonverbal color pretest. Four of the five Ss increased in percent correct nonverbal responses and appear to have acquired discriminations among the 8 programmed colors. The fifth Subject (E) maintained her perfect (100% correct) behavior from nonverbal pretest to posttest.

The results of the verbal posttest when compared with the corresponding pretest indicate it is possible for some Ss to acquire responses not directly programmed. In this case a vocal utterance of E (the color name) served as a discriminative stimulus (S^D) on each visual discrimination trial. Subsequent to the program four of the five Ss were able to vocally emit the words which served as S^Ds in the program when presented the visual S^Ds alone. The one child that did not show this "bonus" effect on the verbal posttest is the only child in the group belonging to what could be described as a typical poverty-level family. This would suggest that this latter finding may not be as obvious when the program is administered to a Head Start population as it was with middle class children. It may be that these acquired "bonuses" are dependent upon a specific type of past history. In this case we are "guessing" that this history must be rich in reinforcement for verbal imitative responses. However, this "guess" is merely a conjecture, one among many, which future research may or may not demonstrate.

FOOTNOTES

[1]The research reported herein was performed pursuant to a contract with the Office of Economic Opportunity, Executive Office of the President, Washington, D.C. 20506. The opinions expressed herein are those of the authors and should not be construed as representing the opinions or policy of any agency of the United States Government.

[2]Now with Webster College, Webster Groves, Missouri.

[3]The "tokens" used were thin plastic chips taken from the Peabody Picture Vocabulary Test.

[4]The colored plastic stimuli used throughout the program and on the pre- and posttests were theatrical gels. These were purchased through the Hub Electric Co., Inc., 2255 W. Grand Ave., Chicago, Illinois.

[5]Set 8 consisted of the posttest.

[6]For examples of fading procedures used in errorless discrimination studies see: Terrace (1963a and 1963b); Moore and Goldiamond (1964); Bijou (in press) and Sidman (1967).

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Fig. 1- VERBAL AND NONVERBAL COLOR PRETESTS: PERCENT CORRECT RESPONSES FOR PROGRAMMED AND NONPROGRAMMED Ss.

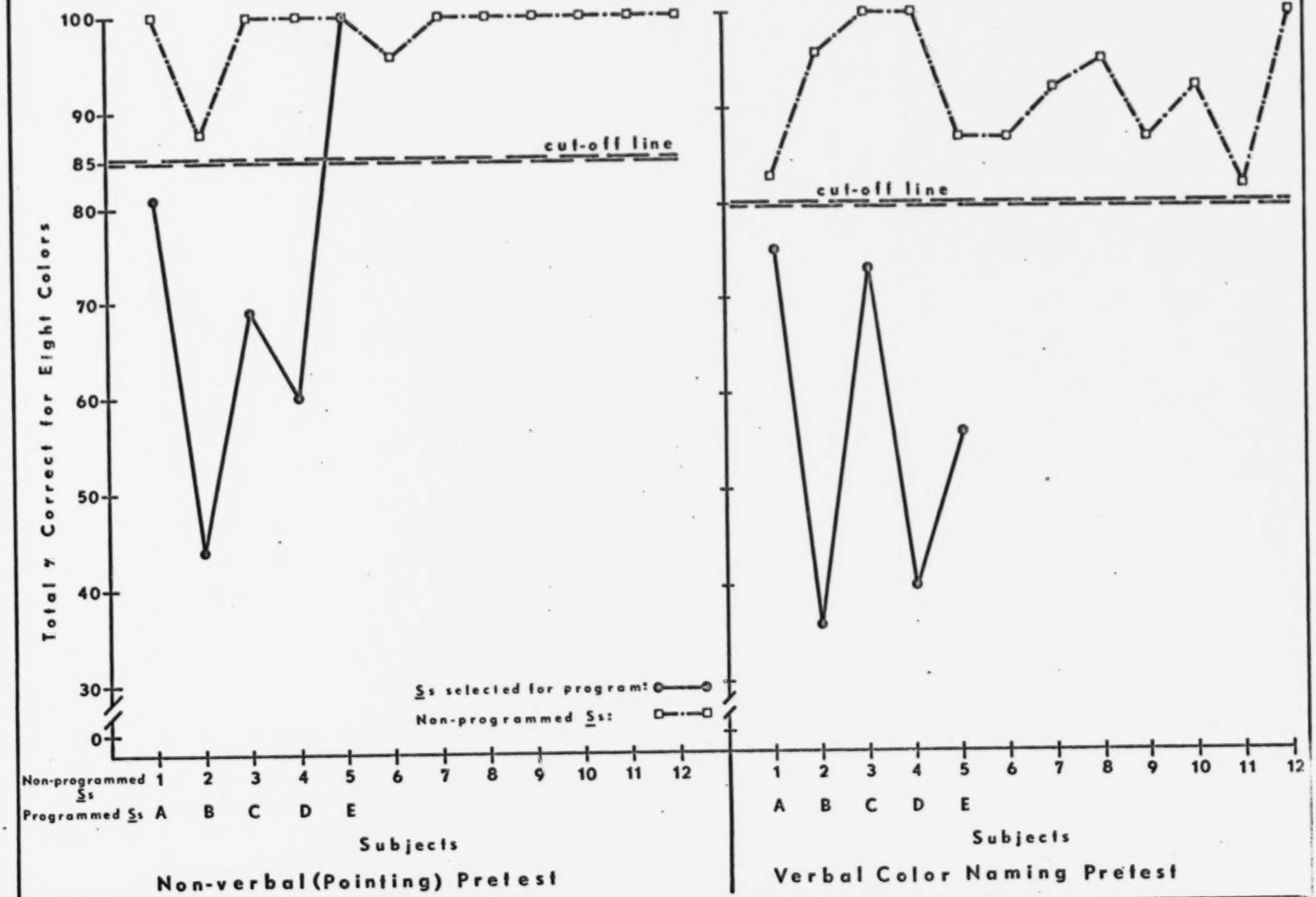

Fig. 2 VERBAL AND NONVERBAL COLOR PRE- AND POST-TEST CORRECT RESPONSES FOR PROGRAMMED Ss.